CHAPTER 13
DIATOMACEOUS EARTH FILTRATION

13-1. GENERAL.

a. Diatomaceous earth filtration is commonly used for swimming pool water and makes use of a dirt-collecting medium which is discarded along with the dirt itself when the filter cycle is completed. Although three or four disposable media can be used in such systems, the one most commonly used is diatomaceous earth. It is therefore adopted as a term of reference to describe such filters throughout this chapter.

b. A cost comparison of different types of filters should be conducted before installing diatomaceous earth filters. These filters have a history of high maintenance and repair cost.

13-2. THE FILTER MEDIA.

a. To the naked eye, diatomaceous earth is a fine white powder, but under the microscope it is seen to possess certain unique properties which make it highly desirable as a filter medium. As an individual particle, it exists in many shapes, all of which resemble a petrified tumbleweed of near microscopic size. It resembles the tumbleweed because it is a lacy, weblike particle which is approximately 90 percent void and 10 percent solid fiber. It is petrified in a literal sense because it is the rigid, skeletonlike fossil of a very small form of plant life from prehistoric times.

b. The characteristics which make diatomite a filter medium can thus be seen when one imagines a cake or crust of small, rigid, porous particles piled one upon the other to form a fine screen, being placed in the path of a flowing stream of water (see figure 13.1). The openings in the screen are large enough to permit the flow of water, but small enough to obstruct the passage of virtually the smallest particle of foreign material. Even droplets of viscous oillike liquids will be caught in the screen. The diatomaceous earth filter cake is therefore a highly efficient filter medium, so efficient in fact, that it requires special care to keep it porous and functioning for extended periods of time.

13-3. THE FILTER SEPTUM.

All diatomaceous earth filters are equipped with septums (often referred to as the filter elements) or devices upon which the diatomaceous earth powder is collected in its cake form. The septum may be a cylindrical tube or a waferlike structure covered with a plastic or metal fabric of sufficiently fine weave to collect the filter cake. The septum is often a bundle of tubes, disks or wafers assembled to a pipe or pipe manifold which receives the filtered water and directs it through the recirculation system piping to the pool.

13-4. PRECOATING THE FILTER SEPTUM.

a. The act of depositing the filter cake upon the septum is called “precoating.” It involves mixing a slurry of diatomaceous earth and water, and then introducing the mixture at a point in the recirculation system which will result in the slurry eventually being deposited upon the septum.

b. The precoat slurry formula provides for a precoat cake thickness of 1/16 of an inch minimum. This is accomplished by preparing a slurry which contains 1/10 pound of diatomite powder for each square foot of septum surface area to be coated. It is good practice to mix a slurry containing 1-1/2 pounds of diatomaceous earth powder for each 10 square feet of septum surface area because some of the slurry will pass through the septum and be deposited in the pool or delivered to waste during the initial precoating of the septum. A precoat thicker than 1/16 inch is not objectionable, but a precoat of inadequate thickness can be a serious operational error. An inadequate thickness will not only reduce filtration efficiency, but will also leave the septum fabric unprotected and exposed to direct soil accumulation. Septum fabric that becomes soiled with sticky organic material will not properly release its soiled filter cake during the cleaning (backwashing) cycle. As a result, the septum itself will become clogged with unreleased filter cake, reducing the available filter surface area and causing the filter to become short-cycled and inefficient.

13-5. CONTINUOUS BODY FEEDING THE FILTER.

a. An operator must understand the function of diatomaceous earth as a filter medium in order to understand why a single precoat of a filter septum will not keep a filter functioning for long. Because the soil is filtered out at the surface of the filter cake, the cake is soon slimed over and clogged with solids which inhibit flow. Such a condition produces very short filter cycles, making the diatomaceous earth system objectionable for this reason alone. It is possible to keep the filter cake porous and to increase its dirt-holding capacity by continuing to feed filter aid (diatomaceous earth) into the system through the process known as

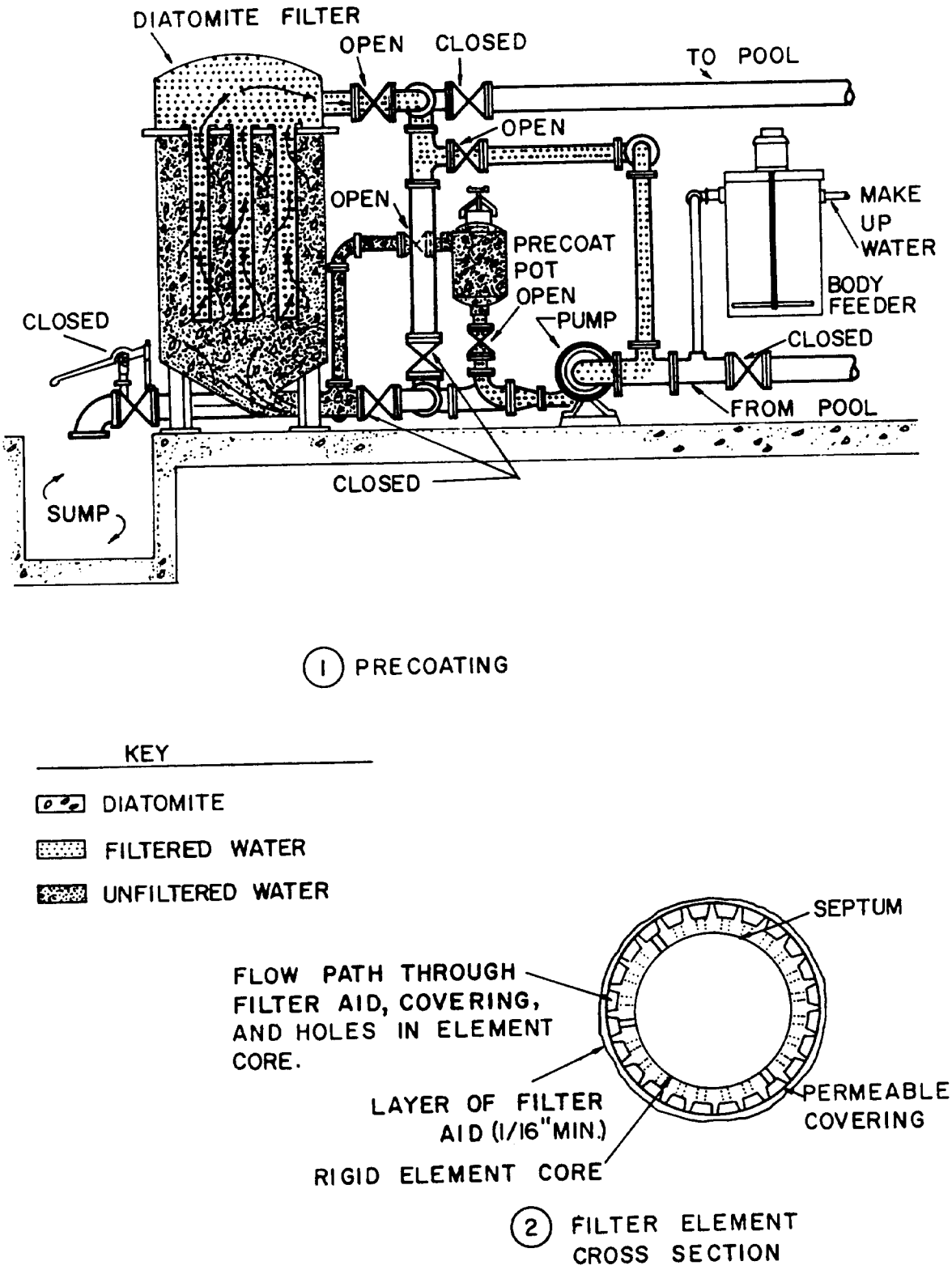

Figure 13.1. Typical diatomite filter

body feeding or slurry feeding. This involves introducing a continuous feed of diatomaceous earth filter powder into the unfiltered pool water as it approaches the filter system. By mixing the porous filter aid particles into the soiled water, the filter cake receives a mixture of particles, some of which are dirt solids, and some of which are porous diatomaceous earth particles which actually increases the dirt-collecting and dirt-holding capacity. Although body feeding causes the filter cake to swell and thicken, it increases its capacity to collect and store soil in the process, so the filter cycle is extended far beyond what would be provided if body feeding were not practiced. (See figures 13.2 and 13-3).

b. The slurry feeding technique is variable and controlled in a highly discretionary manner by the operator. If bathing loads are heavy, with resultant heavy dirt accumulation, the operator increases the rate of body feed. As bathing loads subside the experienced operator continues the heavy feed until the heavy soil accumulation has been largely picked up in the filter. The operator then reduces the rate of feed until the need for heavy feeding is again presented. Body feeding, like chlorine feeding, is measured against demand and the rates are adjusted accordingly.

13-6. THE PHYSICAL PLANT.

Understanding the functions of the filter medium and septum makes the diatomaceous earth filter plant rather easy to visualize. It may be either a closed tank which operates under pressure, or an open tank from which the water is drawn under vacuum to pump suction. In either case the system is comprised of a tank to receive unfiltered water, a septum to support the filter cake, and a pipe or manifold to collect filtered water from the septum and deliver it to the distribution system piping. In the case of the pressure type system, a crock or tank for precoating the filter is attached either to the filter itself or to the adjacent piping. Many shapes, sizes, and design configurations exist be-cause there is a great deal of latitude with respect to septum design and collector piping arrangements. (See figure 13.4)

13-7. DRY FEEDER.

Two types of body feeding equipment are commonly used. The vacuum diatomaceous earth filter may be equipped with a “dry” feeder which consists of a hopper containing the diatomite charge positioned over the filter cell. A vibrator or other device may be used to deposit measured amounts of diatomaceous earth directly into the filter.

13-8. SLURRY FEEDER.

The more common system feeds the filter powder as a slurry. The slurry feeder consists of a tank containing a mixture of diatomite and water, a motor driven agitator or propeller to keep the diatomite in suspension, and a metering pump which draws the slurry from the tank and pumps it to the unfiltered water stream. A relatively dilute slurry is desirable because the diatomaceous earth particles tend to settle and pack or clog at points of low velocity in the pump, fittings, and solution tubing. A ratio of ½ pound of diatomite per gallon of water is probably ideal, but the ratio is not critical; much heavier slurries can be handled if the operator keeps the equipment functioning properly. Regardless of the ratio of diatomite to water, the slurry feed should be prepared daily, if possible, or at least every other day. The diatomaceous earth particle is very brittle and prolonged agitation in the slurry tank will tend to fracture the particles and greatly reduce their efficiency as a filter medium. (See figure 13.5)

13-9. FLOW RATES AND FILTER SIZING.

a. As in the case of the sand filter, the size of the diatomaceous earth filter is governed by the size of the pool. However, because diatomaceous earth filtration is relatively new technology, an inherited flow rate is not available to serve as a guide in sizing the filter system. Instead, the optimum flow rates have been determined from experience in the laboratory and in the field.

b. Experience has shown that the filter flow rate is far more critical in the operation of the diatomaceous earth filter than in the operation of the sand system. It was noted that flow rates can be substantially increased in sand filtration without materially affecting cycles. The diatomite filter, however, gives markedly reduced filter runs as the flow rate is increased. Therefore, it has become common practice to use diatomaceous earth systems of sufficient size that they can be operated at filter flow rates of 1 to 2 gal/min/square foot of filter surface area.

13-10. GENERAL FILTER CLEANING.

The diatomaceous earth filter responds hydraulically to dirt loading in the same manner as the sand filter. As the medium clogs with soil its resistance to the flow of water increases, eventually requiring the medium to be cleaned and recharged with filter powder. The manner in which the filter is to be cleaned is largely predetermined by the manufacturer of the equipment, so there is little reason to discuss the various mechanical systems and procedures which are offered commercially. It is worthwhile, however, to examine the basic differences between the vacuum and pressure type systems.

13-11. VACUUM SYSTEM FILTER CLEANING.

The typical vacuum filter is an open tank. As the recir-

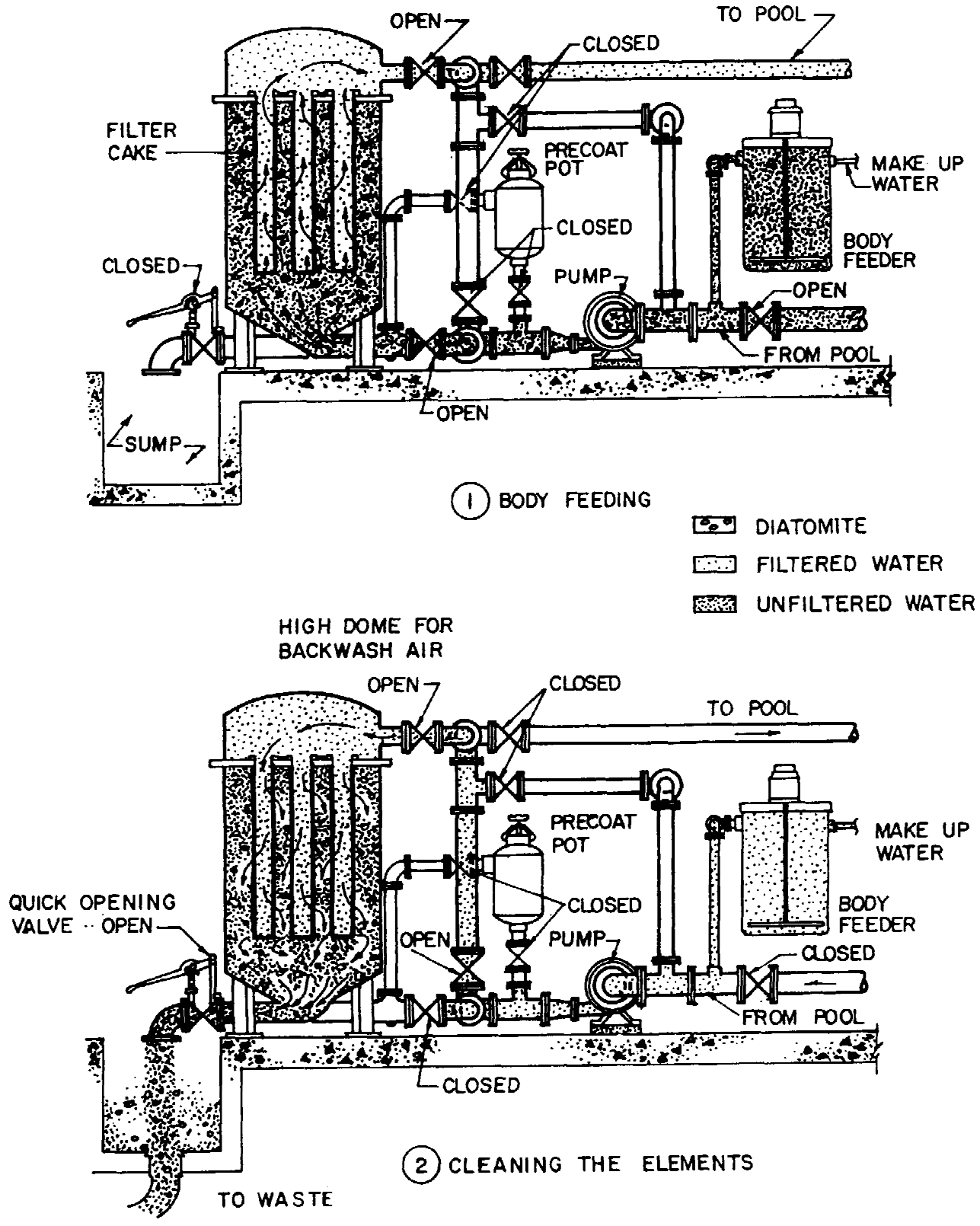

Figure 13.2. Body feeding and cleaning diatomite filters

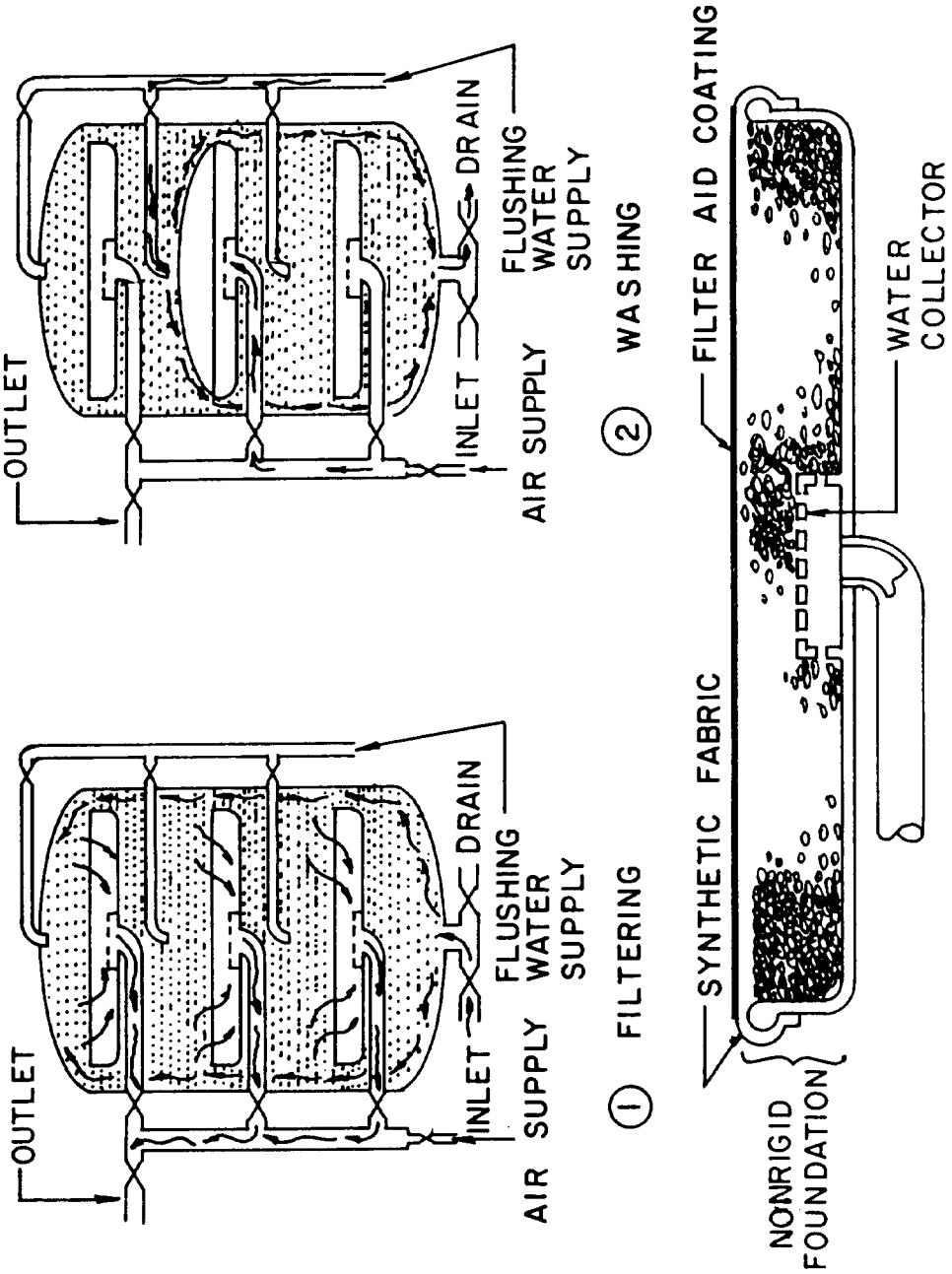

Figure 13.3. Tray type diatomaceous earth filters

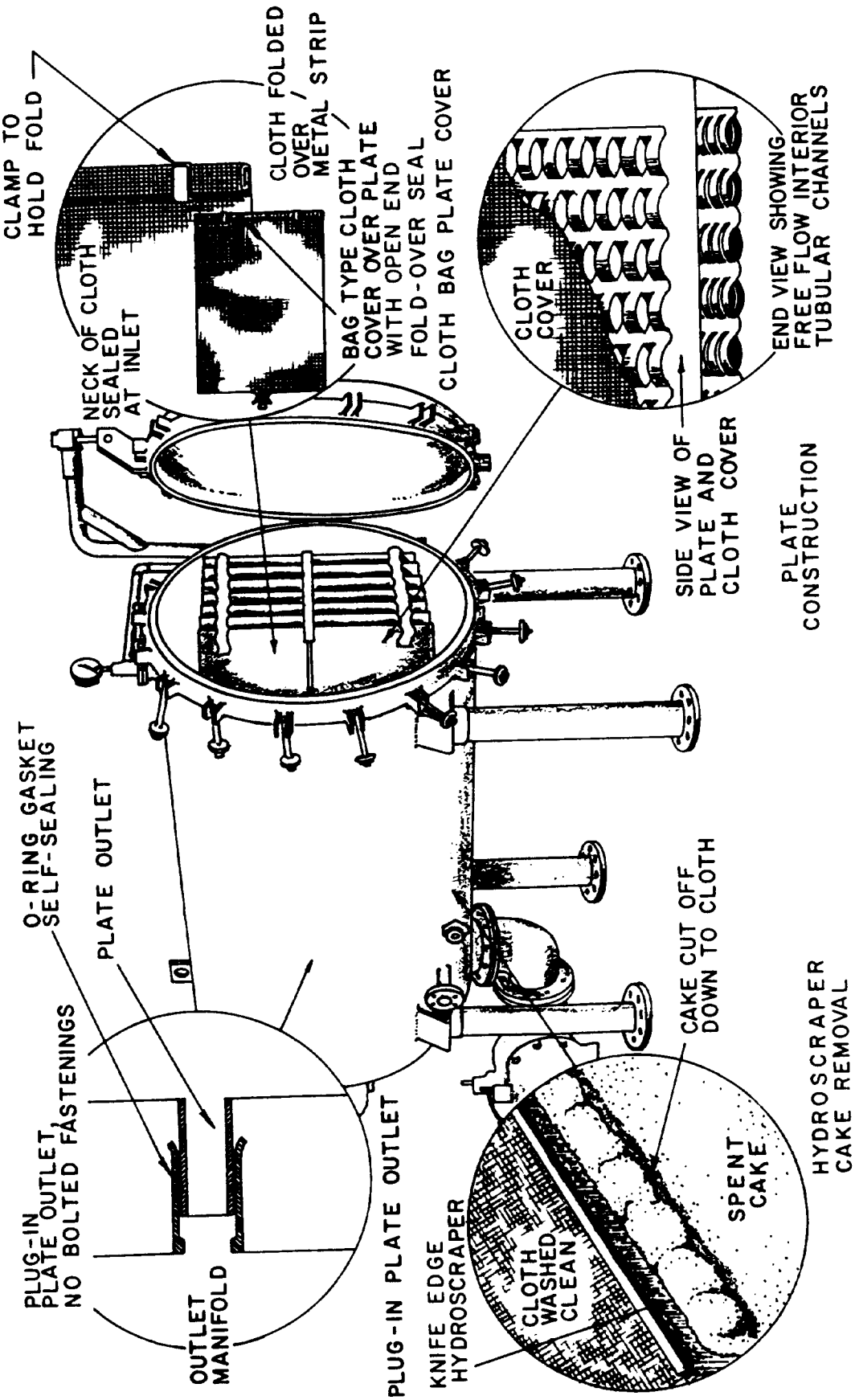

Figure 13.4. Typical heavy-duty diatomite swimming pool pressure filter with flat-type filter plates and cloth plate covers

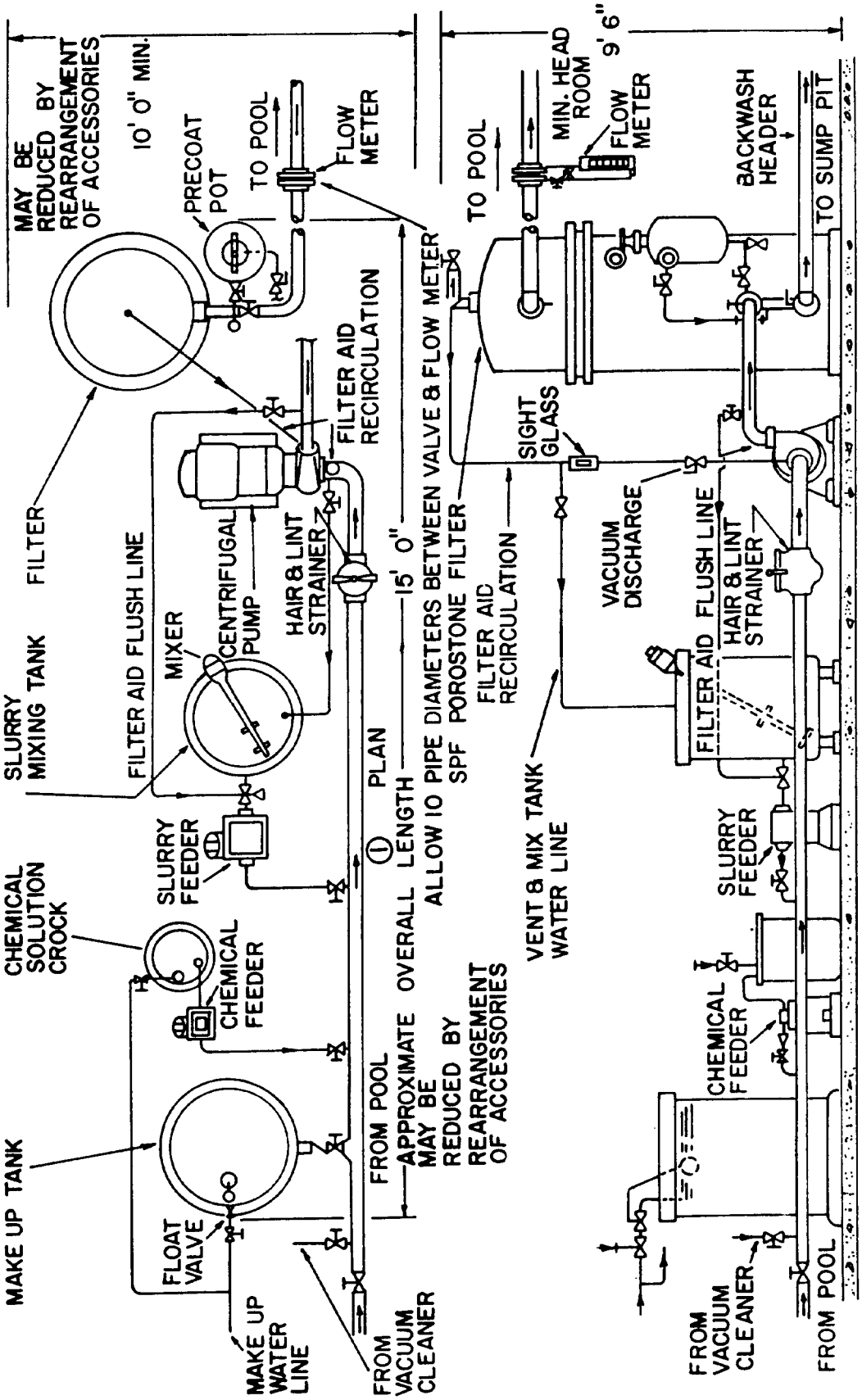

Figure 13.5. Typical filter room equipment

culation pump draws the water through the septum the dirt loading and buildup of the filter cake can be visually observed by the pool operator. When the vacuum gage and flow meter readings indicate that the filter should be cleaned, the pump is stopped, the filter cell is drained, and the elements are manually washed down with the high velocity stream from a garden hose. The operator should make certain that all the soiled cake has been effectively removed from the filter elements before returning the filter to service.

13-12. PRESSURE SYSTEM FILTER CLEANING.

The pressure diatomite filter is normally a tightly sealed vessel which cannot be readily opened for manual cleaning. Instead, the system has a combination of devices and procedures for reversing the flow of water through the septum, to jet spray the elements, or to flex or move the elements within the vessel to assist in releasing the soiled cake, etc. Also, the pressure filter is frequently equipped with visual inspection ports to assist the operator in appraising the efficiency of the cleaning operation.

13-13. INSPECTION SCHEDULE.

The best cleaning systems and techniques, however, will not prevent the eventual accumulation of some soil in the septum fabric and the loss of some filtration efficiency. For this reason it is good practice to periodically open the filter vessel and clean the septum manually. The filter elements and socks should be inspected and cleaned at least every other week. Diatomaceous earth filters should be rebuilt annually.